

REMARKS

Claims 55-56 are pending in this application.

Claims 55-56 stand rejected under 35 U.S.C. § 112, first paragraph as failing to comply with the written description requirement. More specifically, the Office Action states that claims 55 and 56 claim "substantially pure metallic" while the specification discloses only "pure metallic." This rejection is respectfully traversed.

Applicants submit that, although the specification indicates that "along with the (CO₂) groups, the carbon from the deposited saturated organo-rhodium monolayer is removed and a pure metallic rhodium layer forms on the surface of the substrate," it also notes that carbon contamination is "greatly reduced" (and not entirely eliminated), "as carbon is removed with the use of oxygen." (Application at [0037]).

The September 19, 2005 Office Action states that "the specification does not state that only a portion of the carbon is removed it states 'carbon contamination is greatly reduced as carbon is removed with the use of oxygen.'" Applicants submit that this statement in paragraph [0037] does not state that "all" of the carbon is removed; it just states that carbon content is greatly reduced as carbon is removed by the use of oxygen. The specification does not require *all* of the carbon to be removed, as is asserted by the Office Action. Therefore, the specification does disclose the limitation "substantially pure metallic."

Additionally, Applicants point to paragraph [0016] which states that "the term 'rhodium' is intended to include not only elemental rhodium, but rhodium with other trace metals or in various alloyed combinations with other metals as known in the semiconductor art, as long as such rhodium alloy is conductive." This confirms that the "pure metallic" reference in paragraph [0037] refers to the "greatly reduced" carbon

contamination and not to a total lack of any other “trace metals” or “various alloyed combinations” as referenced in paragraph [0016].

Accordingly, the limitation “substantially pure metallic” is disclosed in the specification, and applicants submit that all pending claims are in full compliance with 35 U.S.C. §112.

Claims 55-56 stand rejected under 35 U.S.C. § 102(a) as being anticipated by Soininen et. al. (U.S. Patent No. 6,482,740)(“Soininen”). This rejection is respectfully traversed.

The claimed invention relates to a capacitor comprising a rhodium layer formed by atomic layer deposition. As such, independent claim 55 recites a “capacitor” comprising “a first electrode and a second electrode” and “a dielectric provided between said first electrode and said second electrode.” Independent claim 55 also recites “at least one of said first and second electrode comprising a continuous ALD deposited rhodium film with a substantially pure metallic rhodium composition.”

Independent claim 56 recites a “capacitor” comprising “a first electrode and a second electrode,” “a dielectric provided between said first electrode and said second electrode” and “at least one of said first and second electrode comprising a substantially pure metallic rhodium layer.” Independent claim 56 also recites that the substantially pure metallic rhodium layer is “formed by rhodium atomic layer deposition of dicarbonyl cyclopentadienyl rhodium at a temperature of about 100°C to about 200°C.”

Soininen relates to a method of forming conductive layers suitable for use in an integrated circuit. Soininen teaches that “a metal oxide thin film is deposited on a substrate surface and reduced thereafter essentially into a metallic form with an organic

reducing agent.” (Abstract). According to Soininen, a “metal oxide thin film is grown on the diffusion barrier 14 from alternate pulses of a metal source chemical and oxygen source chemical.” (Col. 7, lines 26-29). Soininen recites that the “pulsing cycle is repeated until the thickness of the metal oxide film is sufficient for seed layer purposes” and then the “metal oxide film is reduced into a metal layer.” (Col. 7, lines 33-36).

The subject matter of claims 55 and 56 is not anticipated by Soininen. Soininen fails to disclose, teach or suggest all limitations of independent claims 55 and 56. Soininen does not disclose, teach or suggest first and second capacitor electrodes, “at least one of said first and second electrode comprising a continuous ALD deposited rhodium film with a substantially pure metallic rhodium composition,” as independent claim 55 recites. Soininen teaches a metal oxide layer formed by ALD, and not an “ALD deposited rhodium film,” much less an “ALD deposited rhodium film with a substantially pure metallic rhodium composition,” as in the claimed invention.

Soininen also fails to disclose, teach or suggest that at least one of the first and second electrodes comprises “a substantially pure metallic rhodium layer formed by rhodium atomic layer deposition of dicarbonyl cyclopentadienyl rhodium at a temperature of about 100°C to about 200°C,” as independent claim 56 recites. In Soininen, the metal film formed at the end of its dual-step process is not “a substantially pure metallic rhodium layer,” much less “a substantially pure metallic rhodium layer” that is “formed by rhodium atomic layer deposition of dicarbonyl cyclopentadienyl rhodium at a temperature of about 100°C to about 200°C,” as in the claimed invention. As noted, Soininen teaches first the formation of a metal oxide film and then subjecting the metal oxide film to an organic reducing agent. Thus, Soininen is silent about an “ALD deposited rhodium film,” or “a substantially pure metallic

rhodium layer” which is “formed by rhodium atomic layer deposition,” as in the claimed invention.

Applicants reaffirm that the limitation “a continuous ALD deposited rhodium film” is not a product-by-process limitation, but rather a *resulting structure* having distinct and defined characteristics. Applicants submit that courts have unanimously recognized that “where it is not possible to define the characteristics which make it (an article) inventive except by referring to the process by which the article is made, he (the Applicant) is permitted to so claim his article, but is limited in his protection to articles produced by his method referred to in the claims.” In re Moeller, 117 F.2d 565, 568 (CCPA 1941).

In the present case, claim 55 recites the limitation “continuous ALD deposited rhodium film” which is a structural limitation and not a product-by-process limitation. A “continuous ALD deposited rhodium film” is a *resulting structure* having distinct and defined characteristics, for example, a particular thickness and composition, such as a reduced carbon content. Applicants submit that a rhodium film with a reduced carbon content cannot be achieved by CVD or PVD, for example, as these processes do not involve a layer-by-layer deposition that could facilitate the removal of carbon.

Additionally, it is believed in the art that a rhodium film produced by the method of Soininen would result in defects and dislocations not present in a rhodium film formed by a continuous ALD process. This is because rhodium oxide (Rh_2O_3) has a density of 8.2 g/cc and rhodium metal (Rh) has a density of 12.4 g/cc. There is only 6.6 grams of rhodium per cc of Rh_2O_3 . Therefore, when Rh_2O_3 is reduced to rhodium metal, it would undergo a large volume change. Accordingly, the rhodium film of Soininen should be less dense and an inferior diffusion barrier when compared to the rhodium film grown directly, as in the present invention. Thus, the limitation “a

continuous ALD deposited rhodium film" is a structural limitation.

For at least the reasons above, Soininen fails to disclose all limitations of claims 55 and 56, and withdrawal of the rejection of these claims is respectfully requested.

In view of the above amendment, applicant believes the pending application is in condition for allowance.

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Respectfully submitted,

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